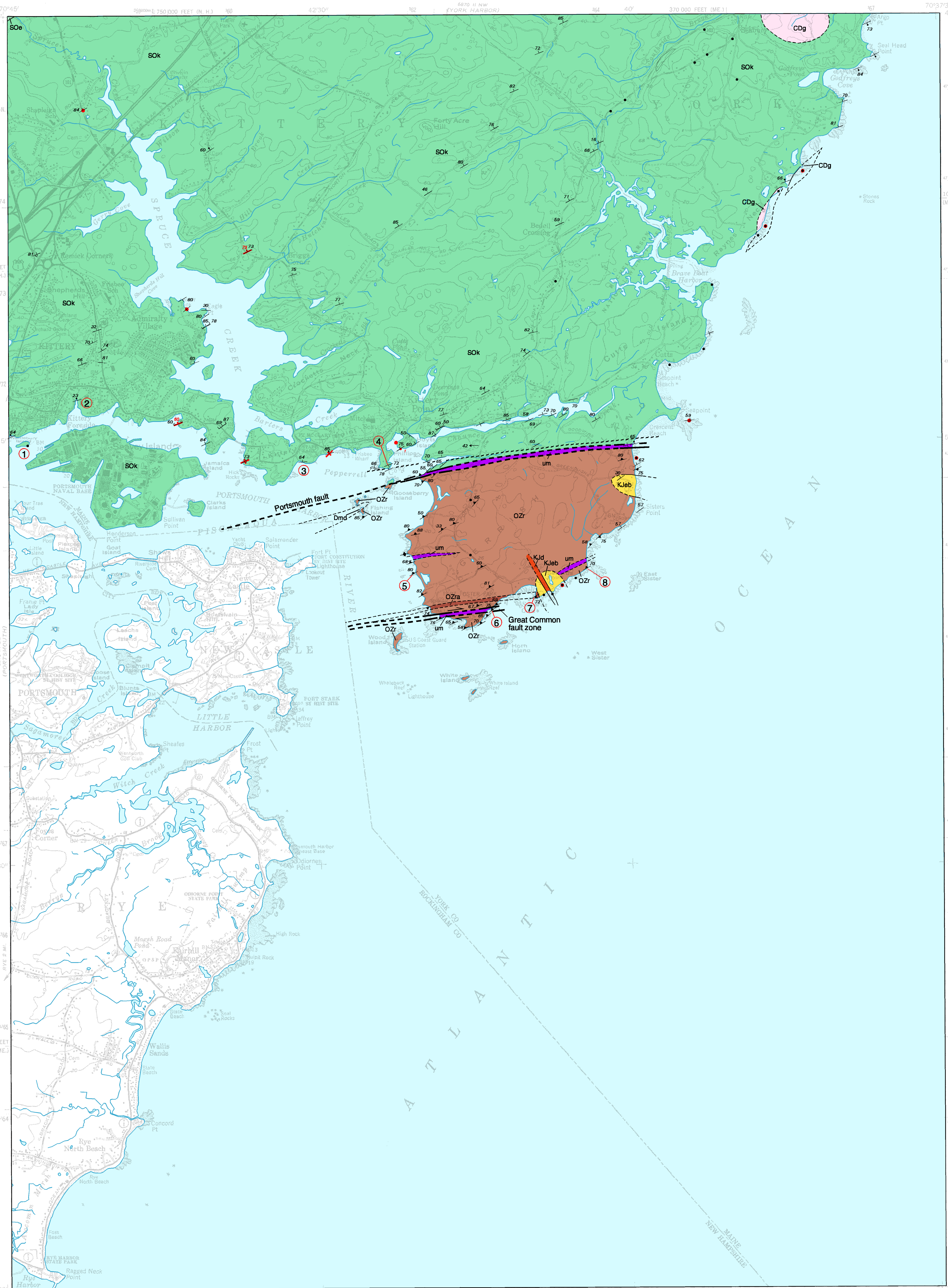

EXPLANATION OF UNITS

INTRUSIVE ROCKS

Cretaceous - Jurassic (?)

KJd — **Diabase.** Large dike on Gerrish Island, mapped to scale. Numerous smaller dikes, some of which are shown by symbols, intrude all rock units.

KJeb — **Explosion breccia.** Angular, randomly oriented blocks up to about a meter across, with virtually no matrix between the blocks. Interpreted as explosion breccia which formed in a volcanic vent (Hussey, 1980). Blocks consist of strongly deformed and migmatitic schist and gneiss typical of the Rye Complex, and fragments of mafic and felsic dike rock. Exposed in two areas on Gerrish Island, Kittery. The northern area, north of Sisters Point, includes a 3-meter block of metasandstone presumed to be of the Kittery Formation.

Carboniferous - Devonian (?)

CDg — **Granite and pegmatite.** Biotite-muscovite granite and pegmatite.

METAMORPHOSED INTRUSIVE ROCKS

Devonian (?)

Dmd — **Metadiorite.** Dark gray, medium-grained, foliated, gneissic metadiorite. Intrudes the Rye Complex.

STRATIFIED ROCKS

Silurian - Ordovician

Merrimack Group

SOk — **Kittery Formation.** Variably thin-bedded to thick-bedded, buff-weathering feldspathic and calcareous metawacke. Characterized by well-developed primary sedimentary structures including graded bedding, channel cut-and-fill structure, small scale cross-bedding, flame structure, and flute casts.

SOe — **Eliot Formation.** Generally thin-bedded, medium gray, calcareous and ankeritic quartz-biotite-chlorite phyllite and metasiltstone, and dark gray biotite-chlorite-muscovite phyllite.

------------------------------ fault ------------------------------

Ordovician-Precambrian

OZr — **Rye Complex.** Heterogeneous unit of variably mylonitic and migmatitic polymetamorphic schists and gneisses. Includes quartz-plagioclase-biotite gneiss, calc-silicate gneiss and biotite gneiss, and quartz-biotite-muscovite-garnet-sillimanite ± staurolite ± andalusite schist and gneiss. These rocks are intruded by various amounts of granite, granodiorite, and pegmatite, generally in concordant or slightly cross-cutting thin sheets. In some places, igneous layers alternate with host gneisses to produce a well layered rock. All rock types are strongly deformed, to produce features such as foliation, porphyroclastic texture, augen gneiss, mylonite, and ultramylonite. Minor amounts of rusty-weathering, dark gray, sulfidic, graphitic schist and impure marble are present on the west shore of Gerrish Island (locality 5).

OZra — **Amphibolite.** Dark gray amphibolite with calc-silicate laminae.

STRONGLY DEFORMED ROCKS

um — **Ultramylonite.** Chalky weathering, dark brown, flinty-textured ultramylonite, locally with pseudotachylyte veins. Thin, unmapped zones occur within the Rye Complex. Mappable zones occur within the Rye Complex, and along major faults. Ultramylonite along the Portsmouth fault zone has a transitional character attributed to a gradual change from Kittery Formation protolith to the north, to Rye Complex protolith to the south in the zone (Swanson and Carrigan, 1984). Ultramylonite along the Great Common fault zone (Southern Mylonite Zone of Hussey, 1980), involves several protoliths. To the north of this complicated structural zone, the Rye Complex is more migmatitic and at higher metamorphic grade than the Rye Complex to the south of the zone (Hussey and Bothner, 1993). Brittle features, including dextral strike-slip faults and pseudotachylyte, of the Fort Foster Brittle Zone are superimposed on the ultramylonites (Swanson, 2006, 2007).

REFERENCES

Carrigan, J. A., 1983, Geology of the Rye Formation, New Castle Island and adjacent areas of Portsmouth Harbor, New Hampshire: M.S. thesis, University of New Hampshire, Durham, 128 p.

Hussey, A. M., II, 1962, The geology of southern York County, Maine: Maine Geological Survey, Bulletin 14, 67 p., map, scale 1:62,500.

Hussey, A. M., II, 1980, The Rye Formation of Gerrish Island, Kittery, Maine – A reinterpretation: The Maine Geologist, v. 7, no. 2, p. 2-3.

Hussey, A. M., II, and Bothner, W. A., 1993, Geology of the coastal lithotectonic belt SW Maine and SE New Hampshire, *in* Cheney, J. T., and Hepburn, J. C. (editors), Field trip guidebook for the northeastern United States: University of Massachusetts, Contribution - Geology Department, no. 67, v. 1, p. K.1-K.19.

Hussey, A. M., II, Bothner, W. A., and Thompson, P. J., 2008, Bedrock geology of the Kittery 1:100,000 quadrangle, Maine and New Hampshire: Maine Geological Survey, Geologic Map 08-78, scale 1:100,000.

Hussey, A. M., II, Rickerich, S. F., and Bothner, W. A., 1984, Sedimentology and multiple deformation of the Kittery Formation, southwestern Maine and southeastern New Hampshire, *in* Hanson, L. S. (editor), Geology of the Coastal Lowlands, Boston, MA to Kennebunk, ME: New England Intercollegiate Geological Conference, Danvers, Massachusetts, p. 47-53.

Rickerich, S. F., 1983, Sedimentology, stratigraphy, and structure of the Kittery Formation in the Portsmouth NH area: M.S. thesis, University of New Hampshire, Durham, 115 p.

Swanson, M. T., and Carrigan, J. A., 1984, Ductile and brittle structures within the Rye Formation of southern coastal Maine and New Hampshire, *in* Hanson, L. S. (editor), Geology of the Coastal Lowlands, Boston, MA to Kennebunk, ME: New England Intercollegiate Geological Conference, Danvers, Massachusetts, trip B4, p. 165-185.

Swanson, M. T., 2006, Pseudotachylyte-bearing strike-slip faults in mylonitic host rocks, Fort Foster brittle zone, Kittery, Maine, *in* Abercrombie, R. E., McGarr, A., Kanamori, H., and Di Toro, G. (editors), Earthquakes; radiated energy and the physics of faulting: Geophysical Monograph, v. 170, p. 167-179.

Swanson, M. T., 2007, Structure of Late Paleozoic brittle dextral strike-slip faults in coastal Maine exosures, *in* Thompson, P. J., Guidebook to field trips in New Hampshire, adjacent Maine & Massachusetts: Geological Society of America, Northeastern Section, 42nd Annual Meeting, p. 3-18.

GEOLOGIC TIME SCALE

Geologic Age		Absolute Age*
Cenozoic Era		0-65
Mesozoic Era	Cretaceous Period	65-142
	Jurassic Period	142-200
	Triassic Period	200-253
Paleozoic Era	Permian Period	253-300
	Carboniferous Period	300-360
	Devonian Period	360-418
	Silurian Period	418-443
	Ordovician Period	443-489
	Cambrian Period	489-542
Precambrian time		Older than 542

* In millions of years before present. (Okulitch, A. V., 2004, Geological time chart, 2004: Geological Survey of Canada, Open File 3040 (National Earth Science Series, Geological Atlas) - REVISION.)

Bedrock Geology of the Kittery Quadrangle, Maine

Bedrock geologic mapping by
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Digital cartography by
Susan S. Tolman

Geologic editing by
Henry N. Berry IV

Cartographic design and editing by
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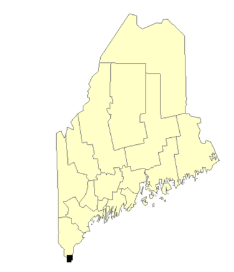
Open-File Map 12-28
2012



Quadrangle Location

TRUE NORTH

SCALE 1 : 24,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

SOURCES OF INFORMATION

Field work by A. M. Hussey II (1970-2003), and published mapping by Hussey (1980), Rickerich (1983), and Carrigan (1983).

Topographic base from U.S. Geological Survey Kittery, Maine-N.H., quadrangle, scale 1:24,000, using standard U.S. Geological Survey topographic map symbols.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.

EXPLANATION OF SYMBOLS

Note: Structural symbols are drawn parallel to strike or trend of measured structural feature. Barb or tick indicates direction of dip, if known. Annotation gives dip or plunge angle. For planar features, symbol is centered at observation point. For linear features, tail of symbol is at observation point. Multiple measurements at a site are represented by combined symbols.

- Outcrop of mapped unit (small exposure, large area of exposure)
- 20 — Bedding, tops unknown (inclined, vertical)
- 20 20 — Bedding, tops known (upright, vertical, overturned)
- 20 — Schistosity (inclined, vertical)
- 20 — Cleavage (inclined)
- 20 — Cleavage, younger than dominant foliation (inclined)
- 20 — Diabase or basalt dike, of Cretaceous-Jurassic(?) age (inclined, vertical, orientation unknown)
- r — Rhyolite dike, of Cretaceous-Jurassic(?) age (orientation unknown)
- 20 — Shear zone (inclined)
- 20 — Axis of minor fold (plunging)
- 4 — **Notable locality.** 1 = metasandstone, Kittery Formation (Stop 4 of Hussey and others, 1984); 2 = thick-bedded, massive metasandstone, Kittery Formation (Stop 3 of Hussey and others, 1984); 3 = metasedimentary rocks with variable bedding thickness and sedimentary structures, Kittery Formation (Stop 2 of Hussey and others, 1984); 4 = sheared rocks, Kittery Formation near the Portsmouth fault zone (Stop 6 of Swanson and Carrigan, 1984); 5 = graphitic-sulfidic schist, marble, and amphibolite, Rye Complex (Stop 7A of Swanson and Carrigan, 1984); 6 = brittle features in ultramylonite, Fort Foster Brittle Zone (Stop #2 of Swanson, 2007; Stop 13C of Hussey and Bothner, 1993); 7 = amphibolite with calc-silicate laminae (Stop 7C of Swanson and Carrigan, 1984; Stop

EXPLANATION OF LINES

- Contact between rock units (well located, approximately located)
- Ductile fault (well located, approximately located)
- Shear zone